4.8.6.4 PASC-Cost

The estimated present value cost to design and install PASC is approximately $2.4 to 3.0 million (U.S. $2005) (see Exhibit 4.8-2). The annual operating and maintenance cost is estimated to be approximately $150,000. Hence the present value of this alternative for 30 years at an annual discount rate of seven percent is approximately $4.4 to 5.1 million. Actual installation costs may vary depending on the details of the final PASC system design and implementation procedures. The operating and maintenance costs may decrease over time depending on the effectiveness of the gravity drain at intercepting water. Exhibit 4.1-7 includes the estimated costs of PASC for the three costing scenarios described in Section 3.2.3.2.3. See Appendix E for supporting information, including assumptions used in the cost analysis.

4.8.6.5 PASC-Effectiveness Over the Long Term

PASC will be effective over the long term. It uses a treatment technology that has proven successful at the Site. Over time, the gravity drain will reduce the amount of CKD-affected groundwater requiring treatment. Thus, there is a high degree of certainty that this alternative will be successful.

Lehigh will operate and maintain the PASC as long as necessary to maintain compliance with cleanup standards. Lehigh will provide a financial assurance mechanism to cover long-term operation and maintenance. Lehigh can add, replace or decommission PASC components as needed, although the in situ nature of the components poses some challenges.

4.8.6.6 PASC-Management of Short-Term Risks

Short-term risks associated with the slurry wall systems and the in situ treatment zone are discussed in section 4.7.6.6. The PASC gravity drain adds some construction risks due to the drilling equipment. During installation, water will emerge at the installation point. As long as the water is clean, as expected, no special measures to protect workers are needed. The risks posed by the FGT components and the gravity drain are manageable with good construction safety practices. As with the other alternatives, it would be best to avoid construction during winter conditions in Metaline Falls.

4.8.6.7 PASC-Technical and Administrative Implementability

4.8.6.7.1 Technical Implementability

While winter months pose difficulties for construction, the PASC is technically implementable during other times of the year.

4.8.6.7.2 Administrative Implementability

The PASC is administratively implementable. See Exhibit 3.2-1, which shows the permits and approvals needed for GWC. Lehigh's research suggests that PASC will meet the conditions connected with these permits and approvals. The FGT components are discussed in Section 4.7.6.7.2. The discharge from the gravity drain may also be covered by an NPDES permit. With the exception of the gravity drain, all of the PASC components reside on Lehigh property. Lehigh will require permission to install and maintain the drain under State Route 31.

See Exhibit 3.2-1, which shows the permits and approvals needed for GWC. Lehigh's preliminary research suggests that PASC will meet the conditions connected with these permits and approvals.

4.8.6.8 PASC-Consideration of Public Concerns

The public will be given an opportunity to review and comment on the dFSTR. Ecology will consider all public comments before finalizing the dFSTR.

4.8.7 PASC-Provide a Reasonable Restoration Time Frame

The treated groundwater from PASC will meet cleanup standards. It is difficult to precisely estimate when all groundwater will meet the cleanup levels for pH and arsenic at the conditional POC for groundwater. Performance and confirmational monitoring allow Lehigh and Ecology to monitor progress. In addition, redundant systems, both for treatment and for performance monitoring, are designed into the PASC alternative to assist in achieving compliance and conducting compliance monitoring. Lehigh will operate PASC indefinitely to maintain compliance with cleanup standards. PASC achieves compliance with groundwater cleanup levels at a conditional POC in approximately the same time frame as other alternatives evaluated in this Revised dFSTR. The restoration time frame for PASC will be further evaluated during detailed design.

4.8.8 PASC-Consider Public Concerns

The public will be given an opportunity to review and comment on the dFSTR. Ecology will consider all public comments before finalizing the dFSTR.

4.8.9 PASC-Prevent Domestic Use of CKD-Affected Groundwater

Measures to prevent domestic use of CKD-affected groundwater are discussed in Section 4.3.9.

5. COMPARATIVE ANALYSIS OF ALTERNATIVES

5.1 Introduction

The six alternatives described in this Revised dFSTR resulted from a thorough collaborative FS process between Lehigh and Ecology. The FSTM screened a list of 20 alternatives. Lehigh and Ecology refined the initial list to yield the six alternatives evaluated in this Revised dFSTR:

- Alternative #1 – Permeable Treatment Wall (PTW)
- Alternative #2 – Pump and Treat (P&T)
- Alternative #3 – Additional Source Control (ASC)
- Alternative #4 – Partial Source Removal (PSR)
- Alternative #5 – Funnel and Gate Treatment (FGT)
- Alternative #6 – Partial Additional Source Control (PASC)

Section 4 of this Revised dFSTR describes how each of the remedy selection criteria applies to the six alternatives. This section compares the evaluation results for the alternatives to arrive at alternative rankings with respect to the remedy selection criteria. Exhibit ES-4 summarizes the rankings.

5.2 Threshold Requirements

As described in Section 4 of this Revised dFSTR, the six alternatives meet the following threshold requirements defined in WAC 173-340-360(2):

- protect human health and the environment;
- comply with cleanup standards;
- comply with applicable federal and state laws; and
- provide for compliance monitoring.

By meeting threshold requirements, the six alternatives passed initial evaluation and were analyzed according to the remaining evaluation criteria. The remainder of this section compares the alternatives using those remaining criteria. With respect to the provision for compliance monitoring, each of the alternatives evaluated in this FS process incorporates treatment-based remedies. There is inherent variability involved in operating engineered treatment systems. The method of evaluating compliance with cleanup standards will be established during development of the monitoring program defined in the CAP and design phases of the project, and ultimately approved by Ecology.

5.3 Use Permanent Solution to the Maximum Extent Practical

5.3.1 Introduction

The disproportionate cost analysis (WAC 173-340-360(3)) criteria evaluations are compared for each alternative in this section. The disproportionate cost analysis criteria are:

- protectiveness;
- permanence;
- cost;
- effectiveness over the long term;
- management of short-term risks;
- technical and administrative implementability; and
- public concerns.

5.3.2 Protectiveness

Each of the alternatives meets cleanup standards, and thus meets the threshold criteria to protect human health and the environment. Under the cost-disproportianailty analysis, protectiveness goes beyond meeting clean up levels. For example, protectiveness additionally examines the degree to which risks are reduced, the time required to reduce risks and risks from implementing the alternative.

PSR poses the greatest short-term risks because it breaches the engineered cover, exposing the formerly Closed CKD Pile to the environment and to workers implementing the alternative. To execute PSR, the formerly Closed CKD Pile and the new temporary dangerous waste storage area for CKD remain open for twenty-five to thirty months, not including winter down-times. PSR also poses serious risks to workers during construction activities on the soft, saturated, and unstable CKD. ASC also involves significant construction risks due to the installation of a slurry wall across the disturbed sediments in the historic landslide area. The remaining alternatives pose short-term risks, but to a far lesser degree. Short-term risks are the greatest for PSR. ASC has the second greatest short-term risks. PASC, FGT, and PTW each have similar short-term risks that are significantly less than for PSR and ASC. GWC has the lowest short-term risk.

If PSR met groundwater cleanup levels throughout the Site in five years, as assumed in the first groundwater treatment scenario, then it would reduce environmental risks to a greater degree than other alternatives, and increases its protectiveness over the long-term. Under the second groundwater treatment scenario, in which groundwater treatment continues indefinitely and groundwater cleanup levels are met at a conditional POC, PSR reduces environmental risks to the same degree that other downgradient treatment–based alternatives do.

Alternatives that require off-site disposal of the CKD waste decrease the overall protectiveness of the remedy. PSR will require the largest volume of off-site disposal, followed by ASC and GWC. PSR disposes of approximately 10,000 cubic yards of CKD, a State dangerous waste as well as approximately 1,000 to 1,500 pounds of non-dangerous waste groundwater treatment residuals. ASC and GWC also produce non-dangerous waste groundwater treatment residuals, approximately 1,000 to 2,000 pounds per year. The alternatives that rely on the in situ carbon dioxide treatment system (PTW, FGT, and PASC) do not produce treatment wastes that must be disposed off-site. ASC, PTW, FGT, and PASC do involve non-dangerous waste excavation spoils that will also need to be managed, but will likely not be disposed off-site.

Considering all the factors that contribute to protectiveness, PASC ranks highest in terms of this criterion. ASC ranks next highest in terms of protectiveness, followed by PTW, GWC, and FGT. The PSR alternative, under both scenarios, ranks the lowest in terms of protectiveness, with the first PSR groundwater treatment scenario being slightly more protective than the second PSR groundwater treatment scenario.

5.3.3 Permanence

According to Lehigh's understanding of MTCA, a remedy, which produces waste for off-site disposal and does not treat the waste and render it harmless (i.e., untreated CKD), is not a permanent remedy. The off-site location is engaged in monitoring and possible future action. PSR, under Lehigh's analysis, is not a permanent remedy because it will not be effective at obviating future groundwater treatment needs. Ecology believes that PSR is permanent. Both Lehigh and Ecology agree that PSR has the highest degree of permanence and that, of the three alternatives that appreciably reduce the amount of CKD-affected water that is generated, PSR exhibits the highest degree of permanence. PSR removes CKD from groundwater, thereby reducing future generation of CKD-affected groundwater. Although other remedies, such as ASC and PASC, re-route water away from the Closed CKD Pile and accomplish source control, the effects are expected to be less than for PSR. Therefore, for the purposes of this disproportionate cost analysis, PSR is the baseline remedy. ASC and PASC exhibit the next greatest degree of permanence because they include a source control component. For ASC the amount of reduction depends, in part, on the size of the slurry wall and effectiveness of the dewatering. The degree of permanence of the PASC depends on the effectiveness of the gravity drain in diverting water away from the CKD. PASC also generates no treatment residuals requiring off-site management.

All six alternatives exhibit a high degree of permanence because they irreversibly treat (i.e., reduce toxicity and mobility of hazardous substances) groundwater by permanently neutralizing the pH and decreasing arsenic levels to meet cleanup levels.

As explained in Section 4, Lehigh's evaluation of the Site shows that none of the six alternatives is a permanent remedy. Regardless, the MTCA regulations require that the analysis rank the alternatives in order of their degree of permanence, with the remedy exhibiting the highest degree of permanence identified as the "baseline" remedy against which the other alternatives are compared. Therefore, PSR is the baseline alternative because it exhibits the highest degree of permanence. ASC and PASC are next, followed by FGT, PTW, and lastly, GWC, in order of decreasing degree of permanence.

5.3.4 Cost

The cost comparisons use a 30-year project duration and seven percent discount rate. Exhibit 4.1-8 shows calculation results for the other cost scenarios described in Section 3.2.3.2.3. The cost of GWC is slightly less than PTW, FGT, and PASC (see Exhibit ES-4). ASC is two or three times more costly than GWC, followed by both PSR scenarios, which is an order of magnitude more expensive than PTW, GWC, FGT, and PASC. All of the alternatives involve indefinite operation and maintenance costs. The only exception is the first groundwater treatment scenario for PSR. Under that scenario, PSR costs include operation, maintenance, and monitoring costs for five years plus monitoring costs for another three years.

The ability to effectuate treatment flexibly in a variety of locations is a critical advantage of the alternatives that employ P&T, especially in this geologic setting. PTW does not offer this advantage; once the trench is installed, the treatment zone cannot be relocated without difficulty, expense, and interruption of treatment. Alternatives with in-situ treatment zones have cost estimates that include periodic treatment zone section replacement. Further, the Site and construction technique constraints prevent a continuous line of in situ carbon dioxide diffusion treatment panels for PTW. The cost estimates for alternatives with P&T components make provisions for relocation or addition of extraction wells. GWC offers some cost benefit related to monitoring, transporting and disposing a lesser amount of treatment residuals (both treated water and solids), compared to P&T alone. This is because GWC incorporates the existing Pilot System.

ASC and PASC will reduce the long-term costs by reducing the volume of water that requires treatment, depending on the effectiveness of the source control components. The actual reduction is not quantifiable at this stage, so that any savings are not included in the cost estimates.

The other cost scenarios shown in Exhibit 4.1-8 are presented for comparison purposes only based on EPA guidance [EPA, 2000a]. The discounted 100-year project duration cost estimates show the same general results as the discounted thirty-year project duration discussed above. The non-discounted 100-year project duration estimates, which do not reflect realistic conditions, ascribe the lowest cost to PTW. In order of ascending costs, FGT, PASC, the first PSR groundwater treatment scenario, and GWC are next. ASC and the second PSR groundwater treatment scenario are the most costly.

5.3.5 Effectiveness Over the Long Term

If installed, operated, and maintained appropriately, each of the six alternatives will be effective over the long term because all six alternatives incorporate downgradient treatment technologies that have proven successful. The treatment components of these alternatives are accessible and are operated, maintained, and replaced as necessary over the long term. However, for the PSR alternative (especially under scenario one where downgradient treatment is operated for a short period), where only portions of the CKD are removed from the water contact, changes in hydrogeologic conditions over the long term will likely decrease the alternative's long term effectiveness. These hydrogeologic changes include landslide shifts and/or a series of heavy water years that create CKD-water contact where none existed at the time of implementation.

Likewise, while the treatment components increase effectiveness over the long term, the source control component of ASC may not contribute to the long-term effectiveness of this alternative. The main component of the ASC alternative, the slurry wall, is not easily accessible. If the slurry wall fails or deteriorates, as it is expected to do over time, then ASC will rely more heavily on the treatment components. In addition, the slurry wall deterioration may lead to focused breakthrough of groundwater retained behind the wall, allowing the water to contact CKD in areas not previously exposed to water contact. Thus, ASC will not be any more effective over the long term, and may be less, than the alternatives that rely solely on treatment (PTW, GWC, and FGT). The source control components of PASC are expected to remain reliable over the long term.

Therefore, PASC and PSR with long term downgradient treatment rank the highest in terms of long-term effectiveness, followed by PTW, GWC, FGT, and PSR with short term treatment and ASC.

5.3.6 Management of Short-Term Risks

PASC, PTW, GWC, and FGT use relatively conventional construction practices, each involving risks that are manageable. These four alternatives rank equally with respect to this criterion (each ranks "easy" on Exhibit ES-4). ASC uses a conventional technology (i.e., slurry wall and dewatering wells). However, because of the danger of activating the historic landslide, ASC has significant short-term risks to workers. Hence, ASC ranks "difficult" on Exhibit ES-4.

PSR uses conventional excavation technologies, but applies them in a soft soil that is unstable and susceptible to liquefaction. PSR opens the engineered cover, thereby exposing the workers and potentially the surrounding population to large amounts of CKD. PSR targets approximately 270,000 cubic yards of CKD for removal. Those 270,000 cubic yards require handling, transport using thousands of loaded truck trips, and temporary storage on approximately 5 acres of lined containment with associated environmental controls. Hundreds of truckloads then move a portion of the CKD to a remote facility for off-site disposal. The rest of the CKD is replaced, recontoured, and the cover systems are reconstructed. Hence, PSR presents significant short-term risk and construction dangers, so that it ranks "very difficult" on Exhibit ES-4.

5.3.7 Technical and Administrative Implementability

Technical Implementability. Each of the alternatives is technically implementable. Each alternative involves a certain amount of complexity in installation. PASC, PTW, GWC, and FGT are less complex than ASC or PSR, which include several significant concerns related to construction. ASC involves work in the vicinity of the historic landslide. PSR involves handling significant quantities of CKD, excavating CKD under liquefiable conditions, counteracting CKD slope instability, transporting CKD on public roads with a large amount of truck traffic, temporarily storing CKD, then returning it to the Site for backfilling and disposing of the amount that no longer fits in the excavation to an off-site disposal facility.

Administrative Implementability. Each of the alternatives is theoretically administratively implementable. Various components of administrative effort will be required for such items as: preparing and recording restrictive covenants, obtaining permits and regulatory approvals, land acquisition/leasing/easements, pertinent to the respective alternative. Land acquisition/leasing/easements required by PSR, ASC, and PASC may be difficult and have the potential to significantly increase the project costs and time needed to implement the alternatives.

PTW ranks the highest for administrative implementability because it does not require the additional effort required to obtain an NPDES permit for discharges of treated groundwater to Sullivan Creek, which is required for the other five alternatives (see Exhibit 3.2-1). Nor would PTW necessitate residuals management such as profiling the waste, and subsequent off-site transport. Lehigh owns all of the land needed to implement GWC, PTW, and FGT, facilitating the administrative implementability of these alternatives. PASC requires permission for a right of way under State Route 31 for the gravity drain. For ASC, the slurry wall and seepage control system may impose administrative difficulty, given portions of the slurry wall and drainage well network must be built on land Lehigh does not own. Lastly, for PSR, the need to obtain approximately five acres for temporary storage of the CKD during the excavation and backfilling phases makes PSR implementation administratively difficult. Since the CKD is regulated as dangerous waste under state law, it will have to be managed in accordance with the dangerous waste regulations while being temporarily stored. This will make PSR more difficult to implement administratively. Each alternative requires the same amount of administrative effort to prepare and record restrictive covenants to preclude the domestic use of water.

Schedule. Section 4 presents the schedules for three major tasks. Except for PTW (which, based on Lehigh's preliminary research, does not need individual permits apart from the MTCA cleanup process regulatory approvals and potential floodplain construction approval), the tasks are: (1) design, contracting, and procurement; (2) permitting; and (3) installation. The alternatives have similar design, contracting, and procurement and permitting schedules. However, they differ significantly with respect to installation schedules. GWC has the shortest installation schedule, followed by FGT. FGT requires less time to install than PTW and PASC, each of which could be installed more rapidly than ASC. PSR requires significantly longer installation time than the other five remedies. It is wise to concurrently work on several of the tasks and sub-tasks involved in permitting and design. Some of the information generated is needed for other tasks and it will expedite implementation. As noted elsewhere, certain tasks should not be implemented during the winter, so that delays could push project execution into a subsequent construction season. Barring unexpected delays in permitting processes, the alternatives require approximately the following amounts of time from CAP finalization to be installed and operational:

- PTW – 12 months;
- GWC – 10 to 11 months;
- ASC – 13 to 14 months;
- PSR – 48 months;
- FGT – 10 to 11 months; and
- PASC – 11 to 12 months.

5.3.8 Public Concerns

The MTCA public review process will give the public several opportunities for input to the remedy selection process. The public will also have the opportunity to review and comment on the project documents. Ecology will address public concerns before finalizing this document. Therefore, public comment will be considered for each of the alternatives, giving them the same ranking for this criterion.

5.3.9 Disproportionate Cost Analysis Results

WAC 173-340-360(3)(e) requires that the alternatives be ranked in order of permanence. In this case, using the assumptions presented in this Revised dFSTR, the alternatives rank as follows in terms of permanence:

1) PSR
2) PASC, ASC
3) FGT, PTW, and GWC

Each of the alternatives includes groundwater treatment for some future time period. None of the alternatives are permanent. PSR groundwater treatment scenario one requires groundwater treatment to occur only over the short-term. Lehigh presented data and analysis supporting its belief that an unattainable degree of effectiveness is